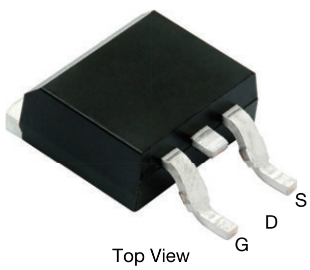
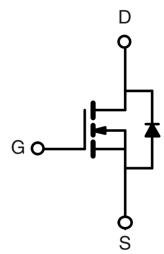
# Automotive N-Channel 60 V (D-S) 175 °C MOSFET

| PRODUCT SUMMARY | |
|---|---|
| $V_{DS}$ (V) | 60 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 10 V | 0.0020 |
| $R_{DS(on)}$ (Ω) at $V_{GS}$ = 4.5 V | 0.0025 |
| $I_D$ (A) | 120 |
| Configuration | Single |

TO-263




N-Channel MOSFET

## FEATURES

- TrenchFET® power MOSFET
- Package with low thermal resistance
- AEC-Q101 qualified
- 100 % $R_g$ and UIS tested
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

RoHS COMPLIANT

HALOGEN FREE

| ORDERING INFORMATION | |
|---|---|
| Package | TO-263 |
| Lead (Pb)-free and Halogen-free | SQM50020EL-GE3 |

**ABSOLUTE MAXIMUM RATINGS** ($T_C$ = 25 °C, unless otherwise noted)

| PARAMETER | | SYMBOL | LIMIT | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | | $V_{GS}$ | ± 20 | V |
| Continuous Drain Current [a] | $T_C$ = 25 °C | $I_D$ | 120 | A |
| | $T_C$ = 125 °C | | 120 | |
| Continuous Source Current (Diode Conduction) [a] | | $I_S$ | 120 | |
| Pulsed Drain Current [b] | | $I_{DM}$ | 300 | |
| Single Pulse Avalanche Current | L = 0.1 mH | $I_{AS}$ | 75 | |
| Single Pulse Avalanche Energy | | $E_{AS}$ | 281 | mJ |
| Maximum Power Dissipation [b] | $T_C$ = 25 °C | $P_D$ | 375 | W |
| | $T_C$ = 125 °C | | 125 | |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{stg}$ | -55 to +175 | °C |

| THERMAL RESISTANCE RATINGS | | | | |
|---|---|---|---|---|
| PARAMETER | | SYMBOL | LIMIT | UNIT |
| Junction-to-Ambient | PCB Mount [c] | $R_{thJA}$ | 40 | °C/W |
| Junction-to-Case (Drain) | | $R_{thJC}$ | 0.4 | |

**Notes**

a. Package limited.
b. Pulse test; pulse width ≤ 300 μs, duty cycle ≤ 2 %.
c. When mounted on 1" square PCB (FR4 material).

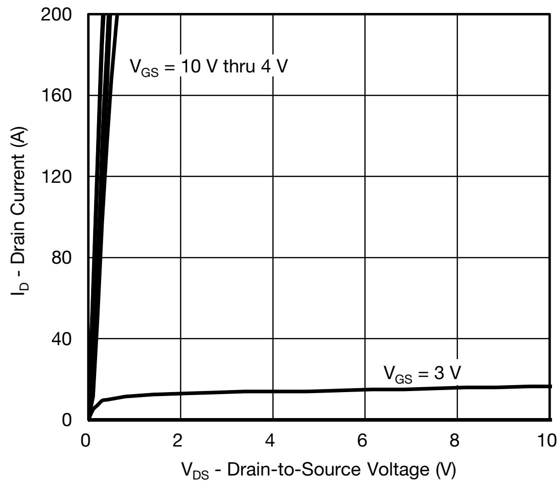
| **SPECIFICATIONS** ($T_C$ = 25 °C, unless otherwise noted) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **PARAMETER** | **SYMBOL** | **TEST CONDITIONS** | | **MIN.** | **TYP.** | **MAX.** | **UNIT** |
| **Static** | | | | | | | |
| Drain-Source Breakdown Voltage | $V_{DS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 µA | | 60 | - | - | V |
| Gate-Source Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$ = $V_{GS}$, $I_D$ = 250 µA | | 1.5 | 2.0 | 2.5 | |
| Gate-Source Leakage | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 60 V | - | - | 1 | µA |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 60 V, $T_J$ = 125 °C | - | - | 50 | |
| | | $V_{GS}$ = 0 V | $V_{DS}$ = 60 V, $T_J$ = 175 °C | - | - | 1.5 | mA |
| On-State Drain Current [a] | $I_{D(on)}$ | $V_{GS}$ = 10 V | $V_{DS}$ ≥ 5 V | 120 | - | - | A |
| Drain-Source On-State Resistance [a] | $R_{DS(on)}$ | $V_{GS}$ = 10 V | $I_D$ = 30 A | - | 0.0016 | 0.0020 | Ω |
| | | $V_{GS}$ = 10 V | $I_D$ = 30 A, $T_J$ = 125 °C | - | - | 0.0031 | |
| | | $V_{GS}$ = 10 V | $I_D$ = 30 A, $T_J$ = 175 °C | - | - | 0.0037 | |
| | | $V_{GS}$ = 4.5 V | $I_D$ = 20 A | - | 0.0020 | 0.0025 | |
| Forward Transconductance [b] | $g_{fs}$ | $V_{DS}$ = 15 V, $I_D$ = 30 A | | - | 164 | - | S |
| **Dynamic** [b] | | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$ = 0 V | $V_{DS}$ = 25 V, f = 1 MHz | - | 12 060 | 15 100 | pF |
| Output Capacitance | $C_{oss}$ | | | - | 5750 | 7200 | |
| Reverse Transfer Capacitance | $C_{rss}$ | | | - | 860 | 1100 | |
| Total Gate Charge [c] | $Q_g$ | $V_{GS}$ = 10 V | $V_{DS}$ = 30 V, $I_D$ = 80 A | - | 128 | 200 | nC |
| Gate-Source Charge [c] | $Q_{gs}$ | | | - | 33 | - | |
| Gate-Drain Charge [c] | $Q_{gd}$ | | | - | 11 | - | |
| Gate Resistance | $R_g$ | f = 1 MHz | | 0.8 | 1.68 | 2.6 | Ω |
| Turn-On Delay Time [c] | $t_{d(on)}$ | $V_{DD}$ = 30 V, $R_L$ = 0.375 Ω<br>$I_D$ ≅ 80 A, $V_{GEN}$ = 10 V, $R_g$ = 1 Ω | | - | 20 | 25 | ns |
| Rise Time [c] | $t_r$ | | | - | 15 | 40 | |
| Turn-Off Delay Time [c] | $t_{d(off)}$ | | | - | 65 | 100 | |
| Fall Time [c] | $t_f$ | | | - | 12 | 20 | |
| **Source-Drain Diode Ratings and Characteristics** [b] | | | | | | | |
| Pulsed Current [a] | $I_{SM}$ | | | - | - | 300 | A |
| Forward Voltage | $V_{SD}$ | $I_F$ = 80 A, $V_{GS}$ = 0 V | | - | 0.88 | 1.5 | V |

**Notes**

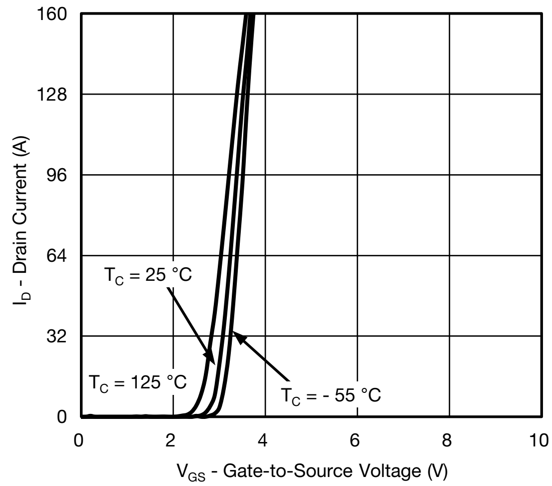
a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %.
b. Guaranteed by design, not subject to production testing.
c. Independent of operating temperature.

*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

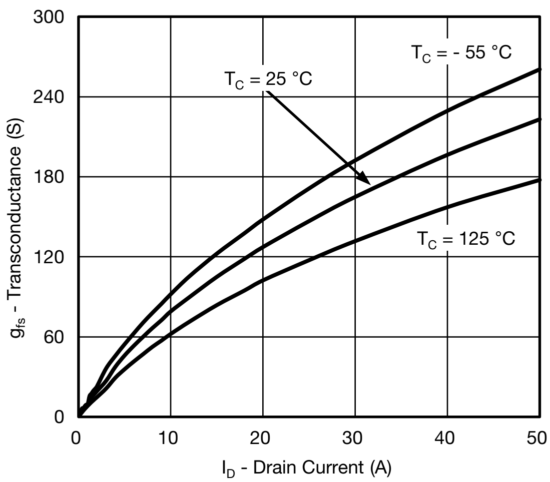
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



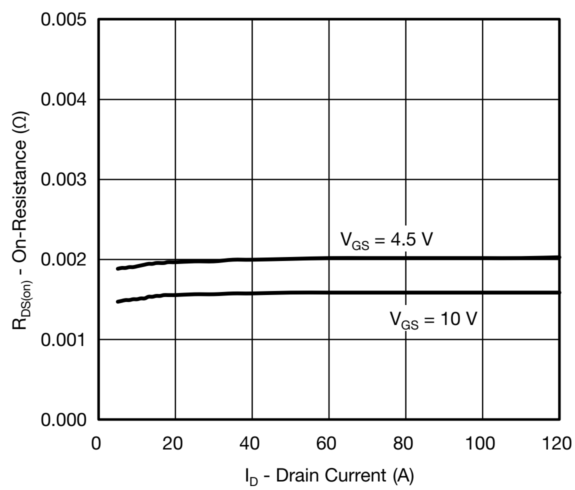

**Output Characteristics**



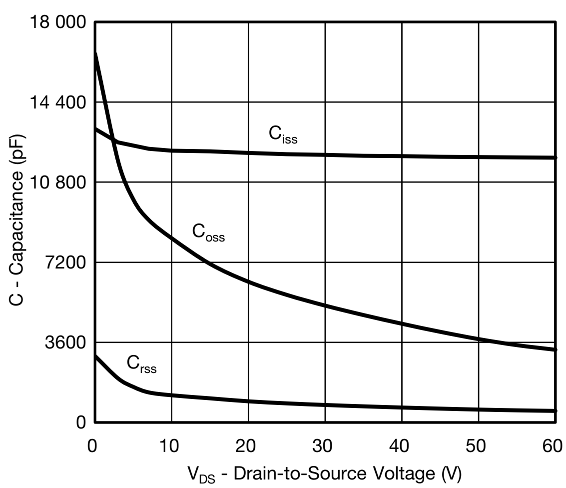

**Transfer Characteristics**



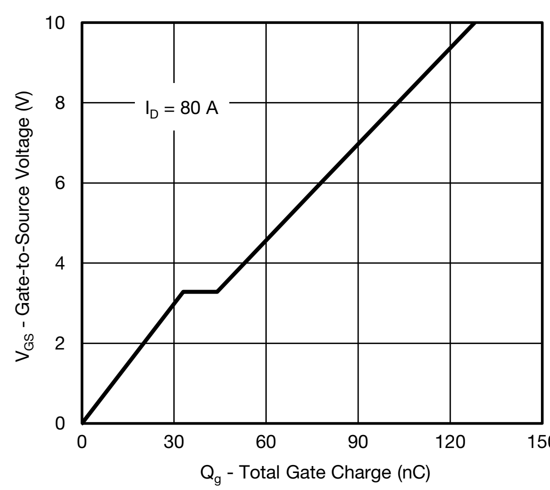

**Transconductance**




**On-Resistance vs. Drain Current**

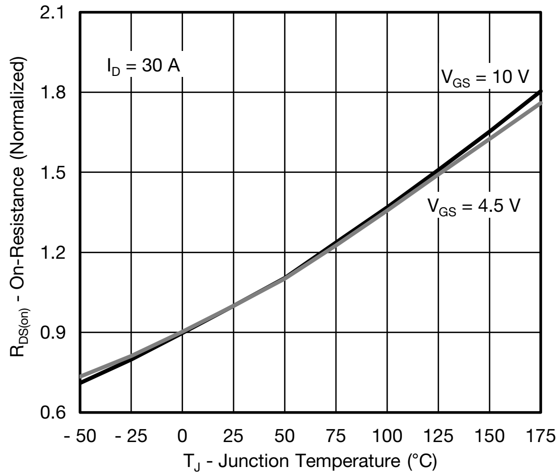



**Capacitance**

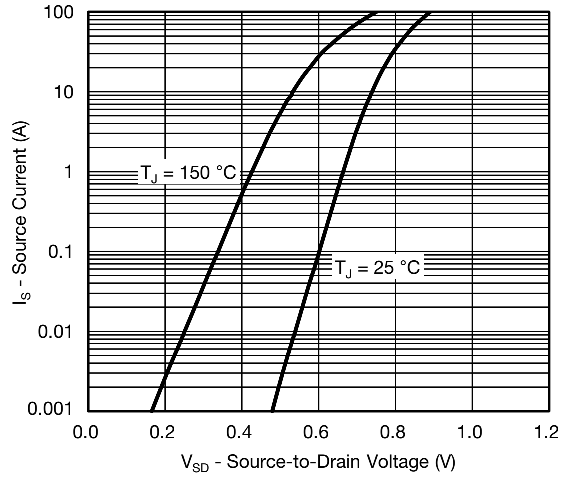



**Gate Charge**

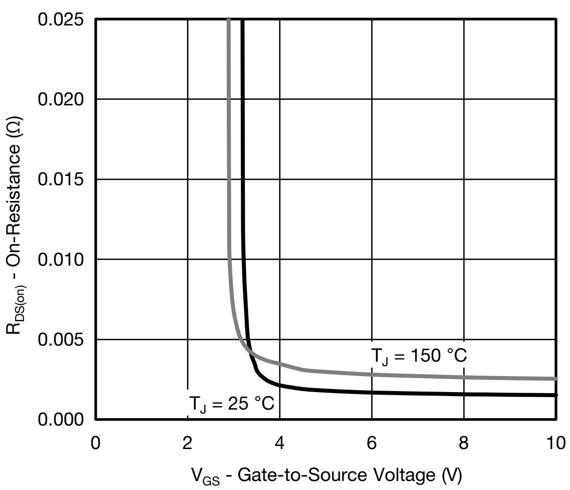
**TYPICAL CHARACTERISTICS** ($T_A$ = 25 °C, unless otherwise noted)



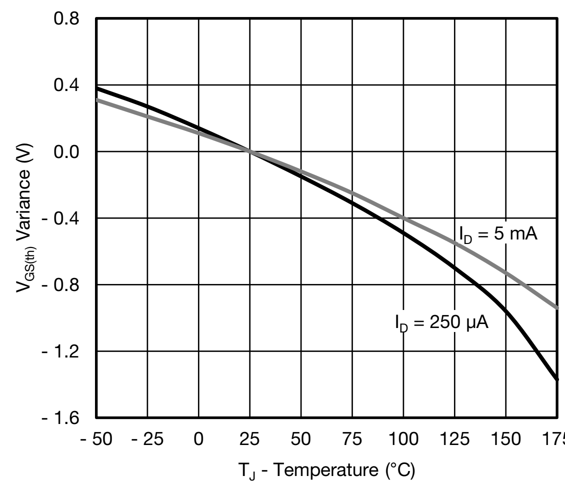

**On-Resistance vs. Junction Temperature**



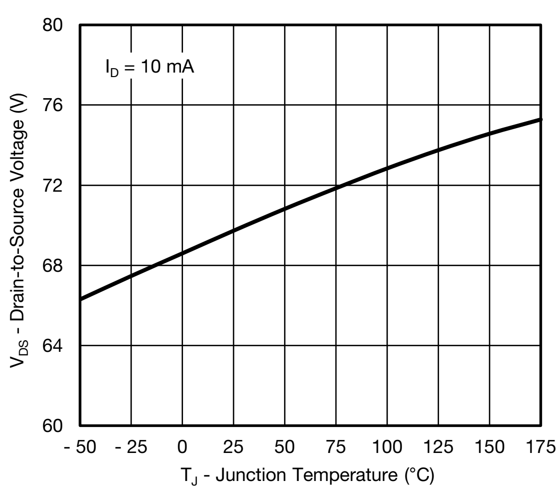

**Source Drain Diode Forward Voltage**



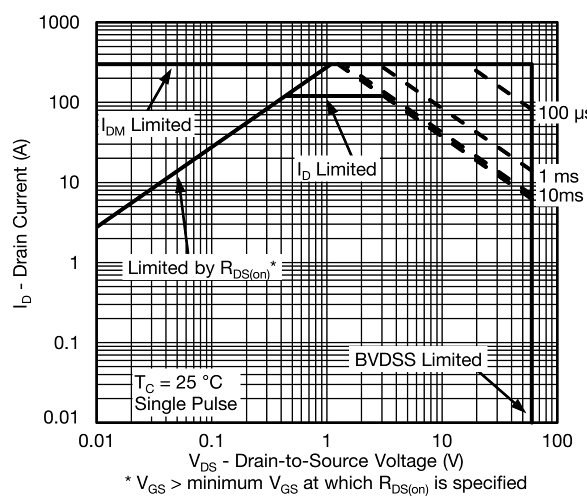

**On-Resistance vs. Gate-to-Source Voltage**




**Threshold Voltage**

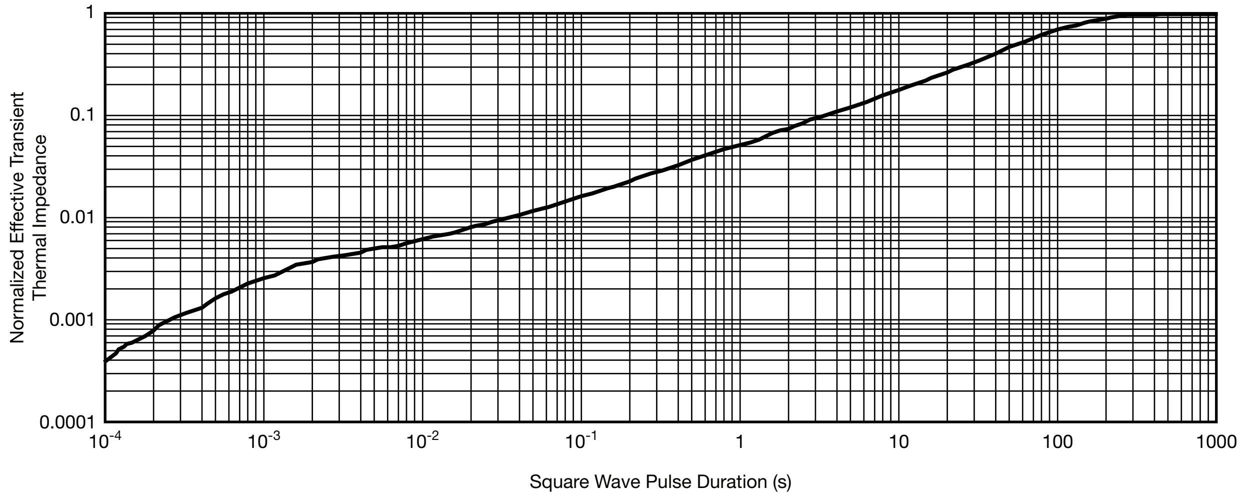



**Drain Source Breakdown vs. Junction Temperature**

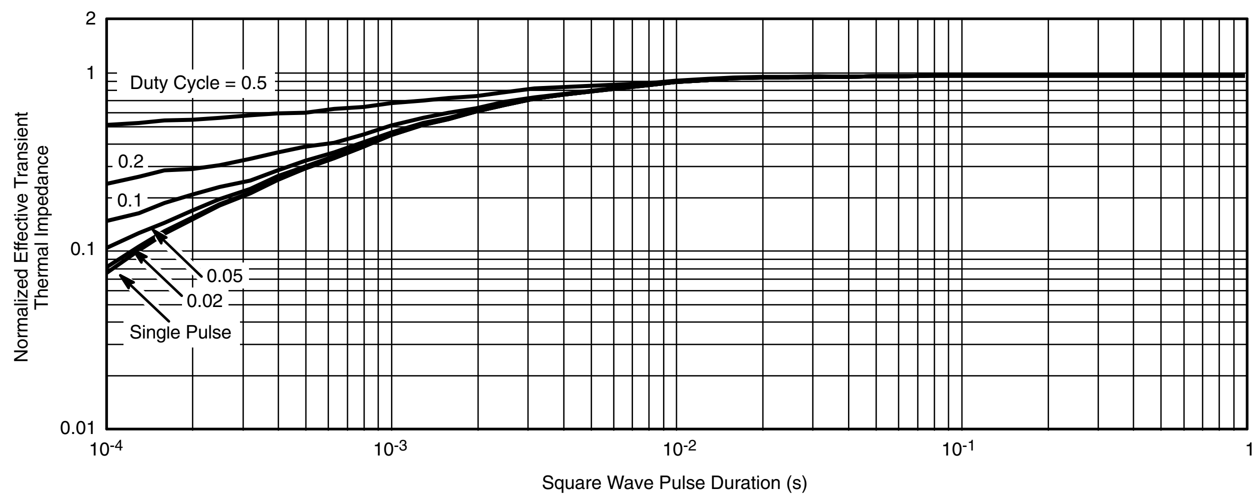



**Safe Operating Area**

**THERMAL RATINGS** ($T_A$ = 25 °C, unless otherwise noted)




**Normalized Thermal Transient Impedance, Junction-to-Ambient**




**Normalized Thermal Transient Impedance, Junction-to-Case**

**Note**

- The characteristics shown in the two graphs
  - Normalized Transient Thermal Impedance Junction-to-Ambient (25 °C)
  - Normalized Transient Thermal Impedance Junction-to-Case (25 °C)

  are given for general guidelines only to enable the user to get a “ball park” indication of part capabilities. The data are extracted from single pulse transient thermal impedance characteristics which are developed from empirical measurements. The latter is valid for the part mounted on printed circuit board - FR4, size 1" x 1" x 0.062", double sided with 2 oz. copper, 100 % on both sides. The part capabilities can widely vary depending on actual application parameters and operating conditions.

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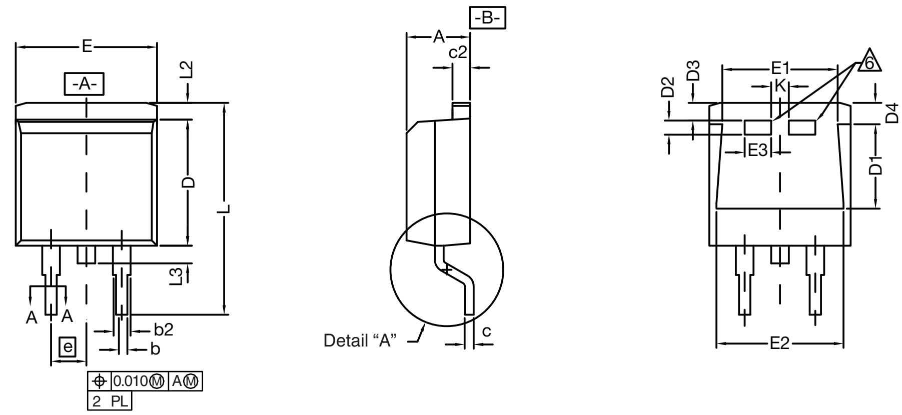
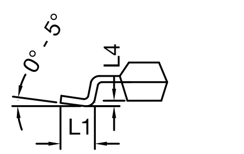
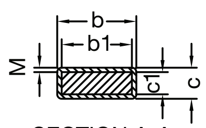
# TO-263 ($D^2PAK$): 3-LEAD




DETAIL A (ROTATED 90°)




SECTION A-A

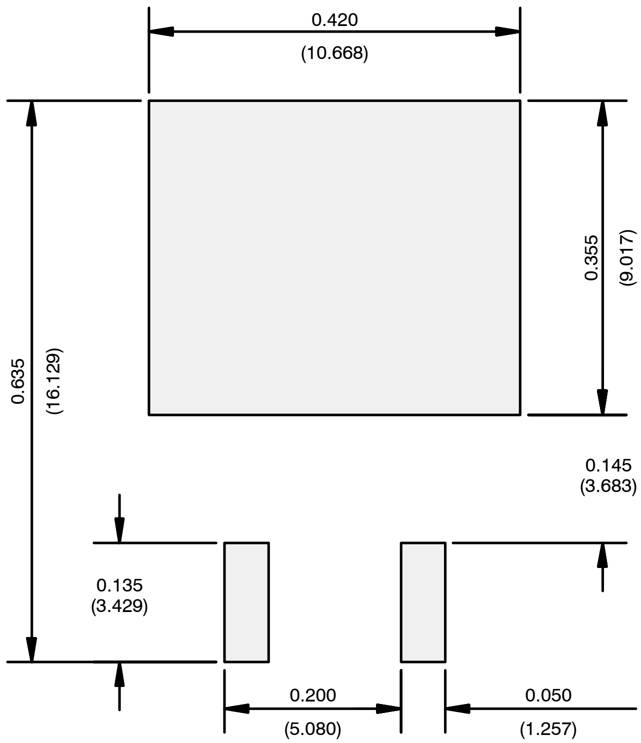
| DIM. | | INCHES MIN. | INCHES MAX. | MILLIMETERS MIN. | MILLIMETERS MAX. |
|---|---|---|---|---|---|
| A | | 0.160 | 0.190 | 4.064 | 4.826 |
| b | | 0.020 | 0.039 | 0.508 | 0.990 |
| b1 | | 0.020 | 0.035 | 0.508 | 0.889 |
| b2 | | 0.045 | 0.055 | 1.143 | 1.397 |
| c* | Thin lead | 0.013 | 0.018 | 0.330 | 0.457 |
| | Thick lead | 0.023 | 0.028 | 0.584 | 0.711 |
| c1 | Thin lead | 0.013 | 0.017 | 0.330 | 0.431 |
| | Thick lead | 0.023 | 0.027 | 0.584 | 0.685 |
| c2 | | 0.045 | 0.055 | 1.143 | 1.397 |
| D | | 0.340 | 0.380 | 8.636 | 9.652 |
| D1 | | 0.220 | 0.240 | 5.588 | 6.096 |
| D2 | | 0.038 | 0.042 | 0.965 | 1.067 |
| D3 | | 0.045 | 0.055 | 1.143 | 1.397 |
| D4 | | 0.044 | 0.052 | 1.118 | 1.321 |
| E | | 0.380 | 0.410 | 9.652 | 10.414 |
| E1 | | 0.245 | - | 6.223 | - |
| E2 | | 0.355 | 0.375 | 9.017 | 9.525 |
| E3 | | 0.072 | 0.078 | 1.829 | 1.981 |
| e | | 0.100 BSC | | 2.54 BSC | |
| K | | 0.045 | 0.055 | 1.143 | 1.397 |
| L | | 0.575 | 0.625 | 14.605 | 15.875 |
| L1 | | 0.090 | 0.110 | 2.286 | 2.794 |
| L2 | | 0.040 | 0.055 | 1.016 | 1.397 |
| L3 | | 0.050 | 0.070 | 1.270 | 1.778 |
| L4 | | 0.010 BSC | | 0.254 BSC | |
| M | | - | 0.002 | - | 0.050 |

ECN: T13-0707-Rev. K, 30-Sep-13
DWG: 5843

**Notes**

1. Plane B includes maximum features of heat sink tab and plastic.
2. No more than 25 % of L1 can fall above seating plane by max. 8 mils.
3. Pin-to-pin coplanarity max. 4 mils.
4. *: Thin lead is for SUB, SYB.
   Thick lead is for SUM, SYM, SQM.
5. Use inches as the primary measurement.
6. This feature is for thick lead.

## RECOMMENDED MINIMUM PADS FOR D²PAK: 3-Lead




Recommended Minimum Pads
Dimensions in Inches/(mm)

Return to Index

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